# Importation of Fresh Garden Bean, *Phaseolus vulgaris* Linnaeus, from Egypt into the Continental United States

## A Qualitative, Pathway-Initiated Pest Risk Assessment

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**Version 1**



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## Executive Summary

The Animal and Plant Health Inspection Service (APHIS) of the United States Department of Agriculture (USDA) prepared this risk assessment document to examine plant pest risks associated with importing commercially produced fresh garden beans, *Phaseolus vulgaris* (Fabaceae), for consumption, in pods or shelled, from Egypt into the continental United States. As the market access request by Egypt did not specify any production, post-harvest, or transportation practices, we assumed no such practices when preparing this risk assessment.

Based on the scientific literature, port-of-entry pest interception data, and information from the government of Egypt, we developed a list of all potential pests with actionable regulatory status for the continental United States that are known to occur in Egypt and to be associated with garden beans anywhere in the world. From this list, we identified seven organisms that have a reasonable likelihood of being on garden beans at the time of harvest and remaining throughout harvest. We analyzed these seven pests in more detail.

Of the pests selected for further analysis, we determined that the following are *not* candidates for risk management, either because there is no endangered area within the continental United States, they did not meet the threshold to likely cause unacceptable consequences of introduction, or because they received a Negligible overall risk rating for likelihood of introduction (i.e., entry plus establishment) into the endangered area via the import pathway: *Bruchus tristis* Boheman (Coleoptera: Bruchidae), *Icerya seychellarum* (Westwood) (Hemiptera: Monophlebidae), and *Maconellicoccus hirsutus* (Green) (Hemiptera: Pseudococcidae).

We determined that the following arthropod pests are candidates for risk management, because they **met the threshold to likely cause unacceptable consequences of introduction**, <u>and</u> they received an overall **likelihood of introduction** risk rating **above** Negligible:

| **Taxonomy** | **Scientific Name** | **Likelihood of Introduction overall rating** |
|---|---|---|
| Lepidoptera: Lycaenidae | *Lampides boeticus* L. | Medium |
| Lepidoptera: Noctuidae | *Chrysodeixis chalcides* (Esper) | Medium |
| | *Helicoverpa armigera* Hübner | Medium |
| | *Spodoptera littoralis* (Boisduvalle) | Medium |

Detailed examination and choice of appropriate phytosanitary measures to mitigate pest risk are part of the pest risk management phase within APHIS and are not addressed in this document.

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# 1. Introduction

## 1.1. Background

This document was prepared by the Plant Epidemiology and Risk Analysis Laboratory of the Center for Plant Health Science and Technology, USDA Animal and Plant Health Inspection Service (APHIS), Plant Protection and Quarantine (PPQ), to evaluate the risks associated with the importation of commercially produced fresh garden beans, *Phaseolus vulgaris* Linnaeus, for consumption, in pods or shelled, from Egypt into the continental United States.

The International Plant Protection Convention (IPPC) provides guidance for conducting pest risk analyses. The methods used here are consistent with guidelines provided by the IPPC, specifically the International Standard for Phytosanitary Measures (ISPM) on 'Pest Risk Analysis for Quarantine Pests, Including Analysis of Environmental Risks and Living Modified Organisms' (IPPC, 2011). The use of biological and phytosanitary terms is consistent with the 'Glossary of Phytosanitary Terms' (IPPC, 2012).

Three stages of pest risk analysis are described in international standards: Stage 1, Initiation; Stage 2, Risk Assessment; and Stage 3, Risk Management. This document satisfies the requirements of Stages 1 and 2.

This is a qualitative risk assessment. We express the risk based on qualitative ratings for the likelihood and consequences of pest introduction via the imported green beans from the Egypt. The details of the methodology and rating criteria are found in the *Guidelines for Plant Pest Risk Assessment of Imported Fruit and Vegetable Commodities, Version 6.0* (PPQ, 2012).

The appropriate risk management strategy for a particular pest depends on the risk posed by that pest. Identification of appropriate phytosanitary measures to mitigate pest risk is undertaken in Stage 3 (Risk Management) and is not covered in this risk assessment. Risk management will be specified in a separate document.

## 1.2. Initiating event

The importation of fruits and vegetables for consumption into the United States is regulated under Title 7 of the Code of Federal Regulations, Part 319.56 (7 CFR §319.56, 2012). Currently, under this regulation, the entry of green beans for consumption in pods or shelled from Egypt into the continental United States is not authorized. This assessment was prepared in response to a request Dr. Ali Soliman, Head of the Central Administration for Plant Quarantine, Ministry of Agriculture and Land Reclamation, Cairo, Egypt to change the Federal Regulation to allow entry (Soliman, 2007).

## 1.3. Determination of the necessity of a weed risk assessment for the commodity

In some cases, an imported commodity may have the potential of becoming invasive in the PRA area. The likelihood that this may happen is evaluated in a weed risk assessment, conducted separately from the commodity risk assessment.

Weed risk assessments do not need to be conducted for plant species that are widely established (native or naturalized) or cultivated in the PRA area, for commodities that are already enterable into the PRA area from other countries, or when the plant part(s) cannot easily propagate on their own or be propagated. We determined that a weed risk assessment is not needed for *Phaseolus vulgaris* because it is widely cultivated in the United States, and is enterable from other countries (APHIS, 2012).

### 1.4. Description of the pathway

The IPPC (2011) defines a pathway as "any means that allows the entry or spread of a pest." In the context of commodity pest risk assessments, the *pathway* is the commodity to be imported, together with all the processes the commodity undergoes that may have an impact on pest risk. In this risk assessment, the specific pathway of concern is the importation of fresh garden beans (*Phaseolus vulgaris* L.) for consumption, in pods or shelled, from Egypt into the continental United States; the movement of this commodity provides a potential pathway for the introduction and/or spread of plant pests.

The following description of this pathway focuses on the conditions that may affect plant pest risk, including morphological and physiological characteristics of the commodity, as well processes the commodity will undergo from production in Egypt through importation and distribution in the continental United States. These conditions provided the basis for creating the pest list and assessing the likelihood of introduction of the pests selected for further analysis; therefore, all components of the pathway, as they are described below, should be considered mandatory conditions for importation of the commodity.

<u>1.4.1. Description of the Commodity</u>

Egypt will be exporting fresh garden beans for consumption, in pods (Fig. 1) or shelled (Fig. 2). The beans are harvested before the seeds mature and harden (Lerner, 2001). This means that the seeds of fresh garden beans, whether they are left inside the pods or shelled, are not mature and therefore cannot produce new plants. Consequently, there is no concern that the seeds may be diverted for planting. Furthermore, the seeds are not a viable pathway for pathogens that are exclusively seed-transmitted or for arthropods that require the mature seed to complete their development. If unrefrigerated, fresh garden beans decompose within a few days, thus ceasing to provide suitable conditions for internal pests.


**Figure 1.** Fresh garden beans in pods. (Image by J.R. Manhart, http://www.metafro.be/prelude/view_plant?pi=09910)

<u>1.4.2. Production and harvest procedures in the exporting area</u>
Production and harvesting procedures have not been specified by the exporting country and are therefore not being considered as part of the risk assessment.

<u>1.4.3. Post-harvest procedures in the exporting area</u>
Post-harvest procedures have not been specified by the exporting country and are therefore not being considered as part of the risk assessment.

<u>1.4.4. Shipping and storage conditions</u>
Beans will be shipped in 3 to 5 kg carton boxes throughout the year via air and maritime shipments (Ministry of Agriculture and Land Reclamation, 2011). Based on standard industry practices, we assume that the beans will be shipped at temperatures of 4-7 degrees C (McGregor, 1987).

## 2. Pest List and Pest Categorization

In this section, we identify the plant pests with actionable regulatory status for the continental United States that could potentially become established in the continental United States as a result of the importation of fresh green beans (*Phaseolus vulgaris* Linnaeus) for consumption, in pods or shelled, from Egypt, and we determine which of these pests meet the criteria for further analysis (Table 2). Pests are considered to be of regulatory significance if they are actionable at U.S. ports-of-entry. Actionable pests include quarantine pests, pests considered for or under official control, and pests that require evaluation for regulatory action.

### 2.1. Pests considered but not included on the pest list

<u>2.1.1. Pests with weak evidence for association with the commodity or for presence in the export area</u>
***Bactrocera cucurbitae*.** De Meyer et al. (2012) report that extensive surveys in Egypt have shown that *B. cucurbitae* does not occur there and that an old report of *B. cucurbitae* from the "Lower Nile Valley, Egypt" could not be confirmed or traced to its origin. EPPO considers this pest to be absent from Egypt (EPPO, 2012a).

***Ceratitis capitata*.** Although Thomas et al. (2005) listed *P. vulgaris* as a *C. capitata* host of "unknown importance," we found no substantiating evidence that *C. capitata* commonly feeds on *P. vulgaris.* For example, during 37 years of surveys in Hawaii this fruit fly has never been detected on *P. vulgaris* (PERAL, 2008, Liquido et al., 1990; Liquido et al., 1991; Thomas et al., 2005). Therefore, we concluded there was insufficient evidence of host association.

***Cryptoblabes gnidiella*.** We think all references to this pest feeding on beans can be traced back to a single sentence (Mau and Kessing, 1992): "In Hawaii, this pest has been recorded on the following hosts: Christmas berry, coffee, corn, green beans, sorghum". We found no other credible evidence to corroborate beans as a host of *C. gnidiella*.

***Dacus ciliatus***. CABI (2012) states "there are a few reports from hosts other than Cucurbitaceae, namely *Adenia gummifera* (Passifloraceae), *Gossypium* sp. (Malvaceae), *Solanum lycopersicum* (Solanaceae) and *Phaseolus* sp. (Fabaceae), but these are not common hosts and may represent aberrant associations or a confused host range". We found no other credible evidence that *D. ciliatus* feeds on *P. vulgaris* or any plant in the family Fabaceae, so we did not list it.

***Retithrips syriacus*.** While *Phaseolus vulgaris* is listed as a host in CABI (2012), we found no other evidence that this thrips feeds on beans.

***Tuta absoluta***. All mentions in the literature of this pest feeding on beans can be traced back to a single report by the NPPO of Italy. The only information available regarding this report is "The NPPO of Italy has recently informed the EPPO Secretariat that *Tuta absoluta* (Lepidoptera: Gelechiidae – EPPO A1 List) has been found on *Phaseolus vulgaris* plants in Sicilia. So far, the pest had mainly been observed on tomato crops (*Lycopersicon esculentum*)" (EPPO, 2009). In the absence of further details and given that *T. absoluta* is a well-researched pest and has never been reported on beans anywhere else in the world it occurs, we believe that this is insufficient evidence that *P. vulgaris* is a host of *T. absoluta*.

***Ralstonia solanacearum* Race 3 Biovar 2** (RSR3B2). Conflicting evidence exists about the host status of *P. vulgaris*. Citing previous reports, Janse et al. (1994) suggested that *P. vulgaris* was a host, despite the fact that the pathogenicity tests *of R. solanacearum* on field-grown mature field beans were not performed. The most current information (Álvarez et al., 2007; Allen, 2012; Allen, 2012) suggests that *P. vulgaris* is a non-host, which is what we concluded.

<u>2.1.2. Organisms with non-actionable regulatory status</u>

We found some evidence of the organisms listed in Appendix A being associated with garden beans for consumption, in pods or shelled and being present in the Egypt; however, because these organisms have non-actionable regulatory status for the continental United States, we did not include them below (Table 2) in this risk assessment.

<u>2.1.3. Organisms identified only to the genus level</u>

In commodity import risk assessments, the taxonomic unit for pests selected for evaluation beyond the pest categorization stage is usually the species (IPPC, 2011), as assessments focus on organisms for which biological information is available. Therefore, generally, we do not assess risk for organisms identified only to the genus level, in particular if the genus in question is reported in the import area. Often there are many species within a genus, and we cannot know if the unidentified species occurs in the import area and, consequently, whether it has actionable regulatory status for the import area. On the other hand, if the genus in question is absent from the import area, any unidentified organisms in the genus can have actionable status; however, because such an organism has not been fully identified, we cannot properly analyze its likelihood and consequences of introduction.

In light of these issues, we usually do not include organisms identified only to the genus level in the main pest list. Instead, we address them separately in this sub-section (Table 1). The information here can be used by risk managers to determine if measures beyond those intended to mitigate fully identified pests are warranted. Often, however, the development of detailed assessments for known pests that inhabit a variety of ecological niches, such as internal fruit feeders or foliage pests, allows effective mitigation measures to eliminate the known organisms as well as similar but incompletely identified organisms that inhabit the same niche.

**Table 1.** Organisms identified to the genus level that are reported on *Phaseolus vulgaris* in Egypt and that have actionable or undetermined regulatory status.

| **Pest Name** | **Evidence of presence on *Phaseolus vulgaris* in Egypt** | **Genus present in the continental United States?** | **Regulatory status[a]** | **Plant part(s) association[b]** | **On harvested plant part(s)?[c]** | **Remarks** |
|---|---|---|---|---|---|---|
| **Acari: Tetranychidae** | | | | | | |
| *Tetranychus* spp. | CABI, 2012; Seif et al., 2001 | Yes (CABI, 2012) | U | Leaves (Seif et al., 2001) | No | |
| **Coleoptera: Meloidae** | | | | | | |
| *Coryna* spp. | Seif et al., 2001 | No (Arnett et al., 2002) | A | Flowers (Seif et al., 2001) | No | |
| *Mylabris* spp. | Seif et al., 2001 | No (*Mylabris* sp. in the family Meloidae are not listed as present) (Arnett et al., 2002) | A | Flowers (Seif et al., 2001) | No | |
| **Collembola: Entomobryidae** | | | | | | |
| *Seira* sp. | Harakly and Assem, 1978 | Yes (based on *S. punctata*) (Bellinger et al., 2012) | U | Occurs in soil (Muturi et al., 2009) | No | |
| **Diptera: Agromyzidae** | | | | | | |
| *Liriomyza* sp. | Elbadry et al., 2006 | Yes (based on *L. huidobrensis*) (CABI, 2012) | U | Leaves (Elbadry et al., 2006) | No | |
| **Hemiptera: Aphididae** | | | | | | |
| *Aphis* spp. | Farrag and Zakzouk, 2000 | Yes (CABI, 2012) | U | Flowers, leaves, shoots, entire plant (based on data for *A. fabae*) (CABI, 2012) | No | This external feeder (CABI, 2012) is highly unlikely to remain after harvesting. |
| **Hemiptera: Cicadellidae** | | | | | | |
| *Empoasca* spp. | Karel and Autrique, 1989 | Yes (based on *E. fabae*) (CABI, 2012) | U | Leaves (based on *E. fabae*) (CABI, 2012) | No | |
| **Lepidoptera: Noctuidae** | | | | | | |
| *Agrotis* spp. | CABI, 2012; Seif et al., 2001 | CABI, 2012 | U | Girdles plants at soil level or below, indicating stems are attacked (Seif et al., 2001) | No | |

| Pest Name | Evidence of presence on *Phaseolus vulgaris* in Egypt | Genus present in the continental United States? | Regulatory status[a] | Plant part(s) association[b] | On harvested plant part(s)?[c] | Remarks |
|---|---|---|---|---|---|---|
| *Spodoptera* spp. | CABI, 2012; Seif et al., 2001 | CABI, 2012 | U | Girdles plants at soil level or below, indicating stems are attacked (Seif et al., 2001) | No | |

[a]A=Actionable, U=Undetermined. If the genus does not occur in the continental United States, the organism has actionable status. If the genus occurs in the continental United States, the organism has undetermined regulatory status, because we cannot know if the unidentified species is one that occurs in the continental United States.
[b]The plant part(s) listed are those for the plant species under analysis. If the information is extrapolated, such as from plant part association on other plant species, this is noted.
[c]"Yes" indicates the pest has a reasonable likelihood of being associated with the harvested plant part(s).

## 2.2. Pest list

Below, we list the actionable pests associated with fresh green beans for consumption, in pods or shelled, that occur in Egypt (Table 2). The list comprises those actionable pests that occur in Egypt on any host and are reported to be associated with fresh green beans for consumption, in pods or shelled, whether in Egypt or elsewhere in the world. For each pest, we indicate 1) the part of the imported plant species with which the pest is generally associated, and 2) whether the pest has a reasonable likelihood of being associated, in viable form, with the commodity following harvesting from the field and prior to any post-harvest processing. We developed this pest list based on the scientific literature, port-of-entry pest interception data, and information provided by the government of Egypt. Pests in shaded rows are pests identified for further evaluation, as we consider them reasonably likely to be associated with the harvested commodity; we summarize these pests in a separate table (Table 3).

**Table 2**. Actionable pests reported on *Phaseolus vulgaris* (in any country) and present in Egypt (on any host

| Pest Name | Evidence of presence in Egypt | Host status [a] | Plant part(s) association [b] | On harvested plant part(s)?[c] | Remarks |
|---|---|---|---|---|---|
| **Acari: Tetranychidae** | | | | | |
| *Eutetranychus africanus* (Tucker) | El Kifl et al., 1974 | Type 1 (El Kifl et al., 1974) | Leaves (based upon *E. orientalis* below) | No | |
| *Eutetranychus orientalis* Klein | El Kifl et al., 1974 | Type 1 (Hill, 1983; Migeon and Dorkeld, 2006; El Kifl et al., 1974) | Leaves [based on information for soybeans (Sullivan and Jones, 2010)] | No | Present in Hawaii (Heu, 2007). |
| **Coleoptera: Bruchidae** | | | | | |
| *Bruchus tristis* Boheman | Gentry, 1965 | Type 1 (Gentry, 1965) | Seed (Gentry, 1965) | Yes | Larvae develop in seeds (Kergoat et al., 2004). |
| **Coleoptera: Chrysomelidae** | | | | | |
| *Aulacophora foveicollis* Lucas (= *Rhaphidopalpa foveicollis* (Lucas)) (CABI, 2012) | CABI, 2012 | Type 1 (CABI, 2012) | Fruit, flowers, leaves, roots, stems (CABI, 2012) | No. Adults feed externally and are very mobile; they are highly unlikely to remain after harvest. | Evidence that this species feeds on *P. vulgaris* is very weak. |
| **Coleoptera: Scarabaeidae** | | | | | |
| *Tropinota squalida (Scopoli)* | Gentry, 1965 | Type 1 (Gentry, 1965) | Flowers (Gentry, 1965) | No | |
| **Diptera: Agromyzidae** | | | | | |
| *Chromatomyia horticola* Goureau (= *Phytomyza horticola* Goureau; *P. atricornis* (partim.) Meigen) (CABI, 2012) | CABI, 2012; Hammad, 1978 | Type 1, *Phaseolus* (beans) are a host (CABI, 2012) | Leaves (CABI, 2012) | No | |
| *Liriomyza bryoniae* Kaltenbach | EPPO, 2006b | Type 1 (CABI, 2012; Harakly and Assem, 1978) | Leaves, stems (CABI, 2012; Spencer, 1965) | No | |

| Pest Name | Evidence of presence in Egypt | Host status [a] | Plant part(s) association [b] | On harvested plant part(s)? [c] | Remarks |
|---|---|---|---|---|---|
| *Liriomyza congesta* (Becker) | Hammad, 1978 | Type 1 (El Kifl et al., 1974) | Leaves (Al-Azawi, 1967) | No | |
| *Melanagromyza sojae* (Zehntner) | Elbadry et al., 2006 | Type 1 (Elbadry et al., 2006) | Leaves, stems (CABI, 2012; Spencer, 1973) | No | |
| *Ophiomyia phaseoli* Tryon (= *Melanagromyza phaseoli* Vanschuytebroeck) (CABI, 2012) | PPQ, 2002 | Type 1 (PPQ, 2002) | Stems, leaves (Hill, 1983; Spencer, 1973) | No | Present in Hawaii (PPQ, 2002). |
| **Hemiptera: Aleyrodidae** | | | | | |
| *Bemisia afer* (Priesner & Hosny) | Abd-Rabou and Ahmed, 2008 | Type 1 (Thindwa and Khonje, 2005) | Leaves (EPPO, 2004) | No | |
| **Hemiptera: Cicadellidae**[1] | | | | | |
| *Balclutha hebe* (Kirkaldy) | Karel and Autrique, 1989 | Type 1 (reported on beans) (Karel and Autrique, 1989) | Leaves (Karel and Autrique, 1989) | No | |
| *Balclutha rosea* (Scott) | Karel and Autrique, 1989 | Type 1 (reported on beans) (Karel and Autrique, 1989) | Leaves (Karel and Autrique, 1989) | No | |
| *Balclutha saltuella* (Kirschbaum) | Karel and Autrique, 1989 | Type 1 (reported on beans) (Karel and Autrique, 1989) | Leaves (Karel and Autrique, 1989) | No | |
| *Cicadulina chinai* (Ghaui) | Hashem et al., 2009 | Type 1 (Hashem et al., 2009) | Leaves (based upon barley, maize and wheat) (Ammar et al., 1989) | No | |
| *Empoasca decedens* (Paoli) (= *Asymmetrasca decedens* (Paoli)) (Jacas et al., 1997) | Hashem et al., 2009 | Type 1 (Hashem et al., 2009) | Leaves, shoots (based upon almond) (Jacas et al., 1997) | No | |

[1] Most pests in this family are very mobile, and therefore highly unlikely to remain after harvest.

| Pest Name | Evidence of presence in Egypt | Host status [a] | Plant part(s) association [b] | On harvested plant part(s)?[c] | Remarks |
|---|---|---|---|---|---|
| *Empoasca decipiens* Paoli | Raupach et al., 2002 | Type 1 (Avidov and Harpaz, 1969) | Leaves (Avidov and Harpaz, 1969) | No | |
| *Empoasca distinguenda* Paoli | El Kifl et al., 1974 | Type 1 (El Kifl et al., 1974) | Leaves, fruits (based upon green pepper and castor oil plants) (El-Dessouki and Hosny, 1969) | No. This very mobile external feeder (El-Dessouki and Hosny, 1969) is highly unlikely to remain after harvesting. | |
| *Empoasca lybica* (de Bergevin) (= *E. signata* (Haupt); *Jacobiasca lybica* (de Bergevin)) (CABI, 2012) | Khalafallah et al., 2006 | Type 1 (Abate and Ampofo, 1996) | Leaves (Avidov and Harpaz, 1969) | No | |
| *Neolimnus egyptiacus* Matsumura (Membracoidea of the World Database, 2010)[2] | Karel and Autrique, 1989; Membracoidea of the World Database, 2010 | Type 1 (reported on beans) (Karel and Autrique, 1989) | Leaves (Karel and Autrique, 1989) | No | |
| *Orosius albicinctus* (= *O. orientalis* Matsumura) (CABI, 2012) | Khodeir, 2006 | Type 1 (Khodeir, 2006) | Leaves (CABI, 2012) | No | |
| *Trialeurodes ricini* (Misra) | EPPO, 2000 | Type 1 (Thindwa and Khonje, 2005) | Fruit, leaves (EPPO, 2000; Shishehbor and Brennan, 1995) | No. Cicadellidae are very mobile external feeders, and are unlikely to remain throughout harvesting. | |

[2] We assumed this was misspelled as *N. aegyptiacus* (Karel and Autrique, 1989), and *Heolimnus aegyptiacus* (Mats.) (El Kifl et al., 1974)

| Pest Name | Evidence of presence in Egypt | Host status [a] | Plant part(s) association [b] | On harvested plant part(s)?[c] | Remarks |
|---|---|---|---|---|---|
| **Hemiptera: Lygaeidae** | | | | | |
| *Spilostethus longulus* Dallas | Gentry, 1965 | Type 1 (Gentry, 1965) | Leaves, seeds, stems (based upon *S. pandurus* on *Calotrcpis*) (Schaefer and Panizzi, 2000) | No. This very mobile external feeder (based upon Roselle; Abdel-Moniem et al., 2011) is highly unlikely to remain after harvest. | |
| **Hemiptera: Miridae** | | | | | |
| *Trigonotylus brevipes* Jakowlef | Gentry, 1965 | Type 1 (Gentry, 1965) | Leaves, flowers (based on *T. caelestialium* on Italian rye grass) (Shiba et al., 2011) | No | Present in Guam and Samoa (Unsinger, 1951). |
| **Hemiptera: Monophlebidae** | | | | | |
| *Icerya seychellarum* (Westwood) | CABI/EPPO, 2008 | Type 1 (Williams and Watson, 1990) | Flowers, fruit, leaves, stems (PPQ, 2002) | Yes | |
| **Hemiptera: Pentatomidae** | | | | | |
| *Agonoscelis puberula* | Gentry, 1965 | Type 1 (Gentry, 1965) | Unknown, but assumed to be leaves, stems and possibly pods, based on general feeding habits of Pentatomidae (Triplehorn et al., 2005). | No. This very mobile, external pest (Triplehorn et al., 2005) is highly unlikely to remain after harvesting. | Present in Texas, New Mexico, and Arizona (Thomas et al., 2003) and not under official control. |
| **Hemiptera: Pseudococcidae** | | | | | |
| *Maconellicoccus hirsutus* (Green) (= *Phenacoccus hirsutus* Green) (CABI, 2012) | CABI/EPPO, 1997 | Type 1 (Ben-Dov et al., 2012) | Fruit, leaves, stems, whole plant (Caribbean Pest Information Network, No Date) | Yes | Present in California, Florida, and Texas (CABI, 2012). |
| **Lepidoptera: Lycaenidae** | | | | | |
| *Lampides boeticus* Linnaeus (= *Cosmolyce baeticus* L.) (El Kifl et al., 1974; Williams, 2008) | Commonwealth Institute of Entomology, 1984 | Type 1 (Grund, 2002) | Flowers, pods (Zimmerman, 1958) | Yes | Present in Hawaii (Zimmerman, 1958). |

| Pest Name | Evidence of presence in Egypt | Host status [a] | Plant part(s) association [b] | On harvested plant part(s)? [c] | Remarks |
|---|---|---|---|---|---|
| **Lepidotera: Noctuidae** | | | | | |
| *Agrotis segetum* (Denis & Schiffermüller) | C.A.B. International, 1987 | Type 1 (Seif et al., 2001) | Stems (Seif et al., 2001) | No | |
| *Autographa gamma* (Linnaeus) (= *Plusia gamma* (Linnaeus) (CABI, 2012) | PPQ, 2002 | Type 1 (PPQ, 2002) | Fruit, flowers, leaves (Sullivan and Jones, 2010) | No. This very mobile external feeder (CABI, 2012; PPQ, 2002) is highly unlikely to remain after harvesting. | |
| *Chrysodeixis chalcites* (Esper) (= *Plusia chalcites* Esper) (CABI, 2012) | Commonwealth Institute of Entomology, 1977 | Type 1 (Robinson et al., 2011) | Leaves, pods (Sullivan and Jones, 2010) | Yes | Present in Hawaii (Commonwealth Institute of Entomology, 1977). |
| *Helicoverpa armigera* Hübner (= *Heliothis armigera* Hübner) (CABI, 2012) | International Institute of Entomology, 1993 | Type 1 (Abate and Ampofo, 1996; Mansour et al., 1981) | Flowers, Flower buds, leaves, pods (Ampofo, 1994) | Yes | |
| *Spodoptera exempta* Walker | CABI, 2012 | Type 1 (Robinson et al., 2007a) | Leaves, shoots, stems (CABI, 2012) | No | Present in California, Hawaii, Kansas, Oregon, Washington, and Wisconsin (CABI, 2012). |
| *Spodoptera littoralis* (Boisduval) (= *Prodenia litura* Fabricius sensu auctorum) (CABI, 2012) | PPQ, 2002 | Type 1 (Afifi and El-Whab, 1990; Robinson et al., 2007b) | Flowers, leaves, pods/seeds, stems (based upon soybeans) (Sullivan and Jones, 2010) | Yes | *S. littoralis* feeds internally on fruit (CABI, 2012) |
| *Syngrapha cicumflexa* (L.) (= *Cornutiplusia circumflexa* (L.)) (Hächler, 1986; Harakly, 1975) | El Kifl et al., 1974; Harakly, 1975 | Type 1, reported on bean (El Kifl et al., 1974) and *Phaseolus* (Harakly, 1975) | Leaves (based on *Phaseolus* spp.) (Harakly, 1975) | No | |

| **Pest Name** | **Evidence of presence in Egypt** | **Host status** [a] | **Plant part(s) association** [b] | **On harvested plant part(s)?**[c] | **Remarks** |
|---|---|---|---|---|---|
| *Thysanoplusia orichalcea* (Fabricius) (= *Diachrysia orichalcea* (Fabricius)) (CABI, 2012) | Zhang, 1994 | Type 1 (CABI, 2012) | Fruit, leaves (CABI, 2012) | No. This very mobile external feeder (CABI, 2012) is highly unlikely to remain after harvesting. | |
| **Lepidoptera: Sphingidae** | | | | | |
| *Agrius convolvuli* (Linnaeus) (= *Herse convolvuli* (Linnaeus)) (CABI, 2012) | EcoPort, 2012 | Type 1 (reported on *Phaseolus* spp. and beans) (Hill, 1983) | Flowers, leaves (Hill, 1983) | No | Present in Hawaii (EcoPort, 2012). |
| **Orthoptera: Acrididae** | | | | | |
| *Aiolopus strepens* Latr. | El Kifl et al., 1974 | Type 1 (El Kifl et al., 1974) | Leaves, whole plant (extrapolated from *A. simulatrix*) (Anonymous, 1978) | No | This very mobile external feeder (El-Minshawy and El-Hinnawy, 1976) is highly unlikely to remain after harvest. |
| *Diabolocatantops axillaris* (Thunberg) | CABI, 2012 | Type 1 (reported on *Phaseolus*) (CABI, 2012) | Leaves, pods, stems (CABI, 2012) | No. This pest is a very mobile external feeder (CABI, 2012). See remarks for *Aiolopus strepens.* | |
| *Eyprepocnemis plorans plorans* (Charpentier) (= *Euprepocnemis plorans* (Charpentier) (Bisby et al., 2012) | El Kifl et al., 1974 | El Kifl et al., 1974 | Leaves (based upon tobacco and broad beans) (Ascher et al., 1989; Rungs, 1962) | No | |
| *Locusta migratoria* (Linnaeus) | CABI, 2012 | Type 1 (reported on *Phaseolus*) (CABI, 2012) | Leaves, pods, stems (CABI, 2012) | No. This pest is a very mobile external feeder (CABI, 2012). See remarks for *Aiolopus strepens.* | |

| Pest Name | Evidence of presence in Egypt | Host status [a] | Plant part(s) association [b] | On harvested plant part(s)?[c] | Remarks |
|---|---|---|---|---|---|
| *Schistocerca gregaria* (Forskål) | EcoPort, 2012 | Type 1 (*Phaseolus* sp. listed as a host) (van Huis et al., 2008) | Flowers, fruit, leaves, shoots, stems, seeds, entire plant (CABI, 2012) | No. This pest is a very mobile external feeder (CABI, 2012). See remarks for *Aiolopus strepens.* | Highly polyphagous pest (CABI, 2012). |
| **Orthoptera: Pyrgomorphidae** | | | | | |
| *Chrotogonus lugubris* Blanch. | El Kifl et al., 1974 | Type 1 (El Kifl et al., 1974) | Leaves [extrapolated from clover, cotton, bean (*Vicia faba*), and wheat] (Abdel Rahman, 2001) | No | This pest is a very mobile external feeder (Abdel Rahman, 2001). |
| **Nematodes** | | | | | |
| *Heterodera cajani* | CABI, 2012 | Type 1 (CABI, 2012) | Root (CABI, 2012) | No | |
| *Hoplolaimus seinhorsti* Luc | CABI, 2012 | Type 1 (CABI, 2012) | Root (CABI, 2012; Coyne et al., 2007) | No | |
| **Mollusks** | | | | | |
| *Helix aspersa* Muller | Zidan, 1997 | Type 1 (Capinera, 2001) | Root, stem (Capinera, 2000) | No | |
| *Theba pisana (Müller)* | Nakhla et al., 1997 | Type 1 (Garrison, 1993) | Leaves, Stem (Garrison, 1993) | No | |
| **Viruses** | | | | | |
| *Faba bean necrotic yellows nanovirus* (FBNYV) | Makkouk et al., 1994; Makkouk et al., 1990 | Type 1 (Makkouk et al., 1990) | Leaves, stem (CABI, 2012) | No | The virus is not seed transmitted.<br><br>Insect vectors are *Acyrthosiphon pisum*, *Aphis craccivora*, and *A. fabae* (Aphididae). Not transmitted by *Myzus persicae*. |

| **Pest Name** | **Evidence of presence in Egypt** | **Host status** [a] | **Plant part(s) association** [b] | **On harvested plant part(s)?**[c] | **Remarks** |
|---|---|---|---|---|---|
| *Cowpea mild mottle virus* (CPMMV) (Tentative Carlavirus) | Brunt et al., 1996 | Type 1(Brunt et al., 1996) | Leaves, stem, possibly seed (systemic chlorosis in leaves) (CABI, 2012) | No | Seed transmission has only been shown experimentally (Brunt and Kenton, 1973). Regardless, immature seeds in green pods would be unable to transmit the virus.<br><br>Vector is *Bemisia tabaci*. |

[a] Type 1 is a natural host, i.e., a plant species that becomes infested or infected by a plant pest in nature under natural conditions (e.g., natural, cultivated and/or unmanaged plants), and the plant pest is sustained on that plant species. Type 2 is a conditional host, i.e. a plant species that is only a host or a non-host under certain conditions. Type 4 refers to situations when the plant is not a food source but serves as a fomite, which is an object or material (including a harvested plant part) that may be contaminated with a pest and that could transmit that pest from one place to another.

[b] The plant part(s) listed are those for the plant species under analysis. If the information is extrapolated, such as from plant part association on other plant species, this is noted.

[c] "Yes" indicates simply that the pest has a reasonable likelihood of being associated with the harvested commodity; the level of pest prevalence on the harvested commodity (low, medium, or high) is qualitatively assessed in Risk Element A1 as part of the likelihood of introduction assessment (section 3).

### 2.3. Pests selected for further analysis

We identified seven arthropod pests for further analysis (Table 3); we found no pathogens or other pests that were candidates for further mitigation. All of these organisms are actionable pests for the continental United States and have a reasonable likelihood of being associated with the commodity plant part(s) at the time of harvest and remaining with the commodity, in viable form, throughout the harvesting process.

**Table 3.** Arthropod pests selected for further analysis.

| Taxonomy | Scientific Name |
|---|---|
| Coleoptera: Bruchidae | *Bruchus tristis* |
| Hemiptera: Monophlebidae | *Icerya seychellarum* |
| Hemiptera: Pseudococcidae | *Maconellicoccus hirsutus* |
| Lepidoptera: Lycaenidae | *Lampides boeticus* |
| Lepidoptera: Noctuidae | *Chrysodeixis chalcites* |
| | *Helicoverpa armigera* |
| | *Spodoptera littoralis* |

## 3. Assessing Pest Risk Potential

### 3.1. Introduction

For each pest selected for further analysis, we estimate its overall pest risk potential. Risk is described by the likelihood of an adverse event, the magnitude of the consequences, and uncertainty. In this risk assessment, we first determine for each pest if there is an endangered area within the import area. The endangered area is defined as the portion of the import area where ecological factors favor the establishment of the pest and where the presence of the pest will result in economically important losses. Once an endangered area has been determined, the overall risk of each pest is then determined by two separate components:

1) the likelihood of its introduction into the endangered area on the imported commodity (i.e., the likelihood of an adverse event), and
2) the consequences of its introduction (i.e., the magnitude of the consequences).

In general, we assess both of these components for each pest. However, if we determine that the risk of either of these components is negligible, it is not necessary to assess the other, as the overall pest risk potential would be negligible regardless of the result of the second component. In other words, if we determine that the introduction of a pest is unlikely to have unacceptable consequences, we do not assess its likelihood of being introduced. Likewise, if we determine there is negligible likelihood of a pest being introduced, we do not assess its consequences of introduction.

The likelihood and consequences of introduction are assessed using different approaches.

For the consequences of introduction, we determine if the pest meets the threshold (Yes/No) of likely causing unacceptable consequences of introduction. This determination is based on estimating the potential consequences of introduction in terms of physical losses (rather than monetary losses). The threshold is based on a proportion of damage rather than an absolute value or amount. Pests that are like to impact at least 10 percent of the production of one or more hosts are deemed "threshold pests."

For likelihood of introduction, which is based on the likelihoods of entry and establishment, we qualitatively assess risk using the ratings Negligible, Low, Medium, and High. The risk factors comprising the model for likelihood of introduction are interdependent and, therefore, the model is multiplicative rather than additive. Thus, if any one risk factor is rated as Negligible, then the overall likelihood will be Negligible. For the overall likelihood of introduction risk rating, we define the different categories as follows:

High: Pest introduction is highly likely to occur.

Medium: Pest introduction is possible, but for that to happen, the exact combination of required events needs to occur.

Low: Pest introduction is unlikely to occur because one or more of the required events are unlikely to happen, or the full combination of required events is unlikely to align properly in time and space.

Negligible: Pest introduction is highly unlikely to occur given the exact combination of events required for successful introduction.

### 3.2. Assessment results

3.2.1. *Bruchus tristis*

We determined the overall likelihood of introduction to be Negligible. We present the results of this assessment in the table below.

**Determination of the portion of the continental United States endangered by *Bruchus tristis***

| | |
|---|---|
| Climatic suitability | *Bruchus tristis* occurs in parts of Europe, southern Russia, and the Middle East (Fauna Europaea, 2012; Gentry, 1965). Based on its global distribution, *B. tristis* could establish in Plant Hardiness Zones 3 to 11 in the continental United States (Fauna Europaea, 2012; Gentry, 1965; Magarey et al., 2008). |
| Potential hosts at risk in PRA area | Suitable hosts for *B. tristis* grow in all of these plant hardiness zones (Gentry, 1965; Magarey et al., 2008; NASS, 2009). |
| Economically important hosts at risk[a] | Economically important hosts in the endangered area are beans and peas (Gentry, 1965; Magarey et al., 2008; NASS, 2009). |
| Pest potential on economically important hosts at risk[a] | *Bruchus tristis* is an important pest on beans and peas in some areas (Gentry, 1965). On *P. vulgaris* in Poland, seed damage from the related weevil, *B. rufimanus*, ranged from 1.2 percent to 63.5 percent depending on the cultivar (Kaniuczak, 2006). In Greece, bruchid infestation rates on legumes ranged from 2.3 percent to 57.1 percent (Bakoyannis, 1987). In Washington state, *B. pisorum* caused up to 50 percent damage on dry peas (Bragg and Burns, 2000). Based on this information, *B. tristis* could cause significant yield losses if introduced into the continental United States. |
| **Defined Endangered Area** | Bean and pea plants in plant hardiness zones 3 to 11 in the continental United States are at risk for *B. tristis* establishment (Gentry, 1965; Magarey et al., 2008; NASS, 2009). |

[a] As defined by ISPM No. 11, supplement 2, "economically" important hosts refers to both commercial and non-market (environmental) plants (IPPC, 2011).

**Assessment of the likelihood of introduction of *Bruchus tristis* into the endangered area via the importation of fresh green beans for consumption, in pods or shelled, from Egypt**

| Risk Element | Risk Rating | Uncertainty Rating[a] | Justification for rating and explanation of uncertainty (and other notes as necessary) |
|---|---|---|---|
| **Likelihood of Entry** | | | |
| Risk Element A1: Pest prevalence on the harvested commodity (= the baseline rating for entry) | High | MU | *Phaseolus vulgaris* is a main host and *B. tristis* feeds in the seeds (Gentry, 1965; Kergoat et al., 2004). We know very little about the prevalence of this species on *P. vulgaris* in Egypt. |
| Risk Element A2: Likelihood of surviving post-harvest processing before shipment | High | U | Production, harvesting, and post-harvest procedures in the exporting area are not being considered as part of the assessment. |
| Risk Element A3: Likelihood of surviving transport and storage conditions of the consignment | High | U | We found no evidence that the standard shipping and storage conditions would lead to an increase or a decrease of the pest population. |
| Risk Element A: Overall risk rating for likelihood of entry | High | N/A | |
| **Likelihood of Establishment** | | | |
| Risk Element B1: Likelihood of coming into contact with host material in the endangered area | Negligible | MU | Specific information on *B. tristis* is lacking, but closely related species do not complete development before seeds have ripened. In *B. rufimanus*, “Most of the larval development and pupation occurs in the hard seeds after harvest in the store” (Medjdoub-Bensaad et al., 2007) and “The adults remain in the seeds and only emerge after sowing” (Crop Genebank Database, 2012). A similar life-history is implied for *B. pisorum* in Brindley, 1946), and *B. brachialis* “emerges from the ripe seeds” of its host plants (Bridwell, 1933). Because fresh garden beans are harvested before the seeds mature, we do not believe that fresh garden beans are a viable pathway for the introduction of *B. tristis*. |
| **Overall Likelihood of Introduction** | | | |
| Combined likelihoods of entry and establishment | Negligible | N/A | |

[a] C=Certain, MC=Moderately Certain, MU=Moderately Uncertain, U=Uncertain

## 3.2.2. *Chrysodeixis chalcites*

We determined the overall likelihood of introduction to be Medium. We present the results of this assessment in the table below.

We determined that the establishment of *C. chalcites* in the continental United States is likely to cause unacceptable impacts. We present the results of this assessment in the table below.

### Determination of the portion of the continental United States endangered by *Chrysodeixis chalcites*

| | |
|---|---|
| Climatic suitability | This insect occurs in southern Europe, Canary Islands, Africa, Mauritius, Cape Verde Islands, and the Middle East (CABI, 2012). Based on this distribution, we estimate this insect could establish in USDA Plant Hardiness Zones 8-11. |
| Potential hosts at risk in PRA Area | *Chrysodeixis chalcites* is polyphagous. Numerous suitable hosts are grown throughout Plant Hardiness Zones 8-11 (see below). |
| Economically important hosts at risk | Economically important hosts in these plant hardiness zones include soybean, tobacco, beans, potato, cauliflower, cucumber, wheat, and corn (CABI, 2012). |
| Pest potential on economically important hosts at risk[a] | Quantitative data on damage is lacking. However, this species is considered as one of the most serious lepidopteran pests in many countries (CABI, 2012). Endangered and Threatened species such as *Solanum* and *Trifolium* spp. (United States Fish and Wildlife Service, 2012) may be affected in the endangered area. |
| **Defined Endangered Area** | Plant hardiness zones 8 to 11 in the continental United States are at risk for *C. chalcites* establishment |

[a] As defined by ISPM No. 11, supplement 2, "economically" important hosts refers to both commercial and non-market (environmental) plants (IPPC, 2011).

### Assessment of the likelihood of introduction of *Chrysodeixis chalcites* into the endangered area via the importation of garden beans from Egypt

| **Risk Element** | **Risk Rating** | **Uncertainty Rating[a]** | **Justification for rating and explanation of uncertainty (and other notes as necessary)** |
|---|---|---|---|
| **Likelihood of Entry** | | | |
| Risk Element A1: Pest prevalence on the harvested commodity (= the baseline rating for entry) | High | U | We found no information about the abundance of this insect on beans, but because it is a common and important pest in Egypt, and beans are a main host, we assume that its prevalence is high. In addition, the pest is an internal feeder and may thus not be easily detected at harvest (CABI, 2012). |
| Risk Element A2: Likelihood of surviving post-harvest processing before shipment | High | U | Production, harvesting, and post-harvest procedures in the exporting area are not being considered as part of the assessment. |
| Risk Element A3: Likelihood of surviving transport and storage conditions of the consignment | High | U | We have found no evidence that the standard shipping and storage conditions would lead to an increase or a decrease of the pest population. |
| Risk Element A: Overall risk rating for likelihood of entry | High | N/A | |

**Assessment of the likelihood of introduction of *Chrysodeixis chalcites* into the endangered area via the importation of garden beans from Egypt**

| Risk Element | Risk Rating | Uncertainty Rating[a] | Justification for rating and explanation of uncertainty (and other notes as necessary) |
|---|---|---|---|
| **Likelihood of Establishment** | | | |
| Risk Element B1: Likelihood of coming into contact with host material in the endangered area | Low | MU | Beans for consumption are usually eaten. Only a tiny fraction will be discarded, and of those, only a tiny fraction will be discarded outdoors. The life stage of the pest entering with green beans would be the larva (CABI, 2012), which has to complete its development to adulthood. Beans will start decomposing at the moment they are discarded outdoors, so pests will only have a short time to complete larval development. Then, pupal development needs to occur. After an adult female emerges, it has to find a male adult, mate successfully, and then locate a host plant. Finally, suitability of climate and availability of hosts would be limited to part of the year in most parts of the endangered area. |
| Risk Element B2: Likelihood of arriving in the endangered area | High | MC | More than 25 percent of the U.S. population lives in the endangered area. |
| Risk Element B: Combined likelihood of establishment | Medium | N/A | |
| **Overall Likelihood of Introduction** | | | |
| Combined likelihoods of entry and establishment | Medium | N/A | |

[a] C=Certain, MC=Moderately Certain, MU=Moderately Uncertain, U=Uncertain

**Assessment of the consequences of introduction of *Chrysodeixis chalcites* into the continental United States**

| Criteria | Meets criteria? (Y/N) | Uncertainty Rating[a] | Justification for rating and explanation of uncertainty (and other notes as necessary) |
|---|---|---|---|
| **Direct Impacts** | | | |
| Risk Element C1: Damage potential in the endangered area | Yes | MC | *Chrysodeixis chalcites* causes “considerable” damage to tomatoes, is one of the most important noctuid pests of fodder crops in Israel, is one of the principal arthropod pests on soybean in Italy, is considered the most serious semi-looper pest attacking field fruit and vegetables in Egypt, and is a serious pest of potato in Mauritius (CABI, 2012). Consequently, *C. chalcites* |

| Criteria | Meets criteria? (Y/N) | Uncertainty Rating[a] | Justification for rating and explanation of uncertainty (and other notes as necessary) |
|---|---|---|---|
| | | | could cause significant economic damage in the endangered area. |
| Risk Element C2: Spread potential | Yes | C | *Chrysodeixis chalcites* sometimes migrates from southern to northern Europe, or to Africa (CABI, 2012). This demonstrates the ability of this species to move long distances. |
| Risk Element C: Pest introduction is likely to cause unacceptable direct impacts | Yes | N/A | |
| **Conclusion** | | | |
| Is the pest likely to cause unacceptable consequences in the PRA area? | Yes | N/A | |

[a] C=Certain, MC=Moderately Certain, MU=Moderately Uncertain, U=Uncertain

### 3.2.3. *Helicoverpa armigera*

We determined the overall likelihood of introduction to be Medium. We present the results of this assessment in the table below.

We determined that the establishment of *H. armigera* in the continental United States is likely to cause unacceptable impacts. We present the results of this assessment in the table below.

**Determination of the portion of the continental United States endangered by *Helicoverpa armigera***

| | |
|---|---|
| Climatic suitability | This insect is widely distributed and occurs throughout Europe, the Middle East, Central and South Asia, the Far East, Africa, Australia, and Oceania (CABI, 2012). Based on this distribution, we estimate establishment is possible in USDA Plant Hardiness Zones 5-11. |
| Potential hosts at risk in PRA Area | Numerous suitable hosts are grown throughout plant hardiness zones 5-11 (see below). |
| Economically important hosts at risk | Economically important hosts in plant hardiness zones 5-11 include cotton, pigeon pea, chickpea, tomato, okra, pea, soybean, tobacco, potato, corn, and citrus (CABI, 2012). |
| Pest potential on economically important hosts at risk[a] | *Helicoverpa armigera* is a serious economic pest. In India, it routinely destroys over half of the pigeon pea and chickpea crops (Reed and Pawar, 1982), and 10-100 percent damage has been reported on potato (Parihar and Singh, 1988). In New Zealand, an outbreak of this pest once caused major damage to *Pinus radiata* trees (50 percent of foliage consumed on over 60 percent of the trees) (CABI, 2012). The pest is also economically very important in several European countries (CABI, 2012). |

| | |
|---|---|
| **Defined Endangered Area** | Cotton, tomato, okra, pea, soybean, tobacco, potato, corn, citrus, and other crops (see above) in plant hardiness zones 5 to 11 in the continental United States are at risk for *H. armigera* establishment. |

[a] As defined by ISPM No. 11, supplement 2, "economically" important hosts refers to both commercial and non-market (environmental) plants (IPPC, 2011).

**Assessment of the likelihood of introduction of *Helicoverpa armigera* into the endangered area via the importation of garden beans from Egypt**

| Risk Element | Risk Rating | Uncertainty Rating[a] | Justification for rating and explanation of uncertainty (and other notes as necessary) |
|---|---|---|---|
| **Likelihood of Entry** | | | |
| Risk Element A1: Pest prevalence on the harvested commodity (= the baseline rating for entry) | High | MC | *Helicoverpa armigera* is widespread in Egypt and *P. vulgaris* is among the main hosts of this pest (CABI, 2012). |
| Risk Element A2: Likelihood of surviving post-harvest processing before shipment | High | U | Production, harvesting, and post-harvest procedures in the exporting area are not being considered as part of the assessment. |
| Risk Element A3: Likelihood of surviving transport and storage conditions of the consignment | High | U | We found no evidence that the standard shipping and storage conditions would lead to an increase or a decrease of the pest population. |
| Risk Element A: Overall risk rating for likelihood of entry | High | N/A | |
| **Likelihood of Establishment** | | | |
| Risk Element B1: Likelihood of coming into contact with host material in the endangered area | Low | MC | Beans for consumption are usually eaten. Only a tiny fraction will be discarded, and of those, only a tiny fraction will be discarded outdoors. The life stage of the pest entering with green pods would be larvae (CABI, 2012), which have to complete development before they could fly to a host plant. Beans will start decomposing as soon as they are discarded, so larval development would have to be completed in a short time. Then, pupal development needs to successfully occur. After a female emerges, it would have to find an adult male, mate successfully, and then find a host plant. Finally, suitability of climate and availability of hosts would be limited to part of the year in most parts of the endangered area. |
| Risk Element B2: Likelihood of arriving in the endangered area | High | MC | More than 25 percent of the U.S. population lives in the endangered area. |
| Risk Element B: Combined | Medium | N/A | |

| Risk Element | Risk Rating | Uncertainty Rating[a] | Justification for rating and explanation of uncertainty (and other notes as necessary) |
|---|---|---|---|
| likelihood of establishment | | | |
| **Overall Likelihood of Introduction** | | | |
| Combined likelihoods of entry and establishment | Medium | N/A | |

[a] C=Certain, MC=Moderately Certain, MU=Moderately Uncertain, U=Uncertain

**Assessment of the consequences of introduction of *Helicoverpa armigera* into the continental United States**

| Criteria | Meets criteria? (Y/N) | Uncertainty Rating[a] | Justification for rating and explanation of uncertainty (and other notes as necessary) |
|---|---|---|---|
| **Direct Impacts** | | | |
| Risk Element C1: Damage potential in the endangered area | Yes | MC | As discussed above (Endangered Area table), this pest can be a serious economic pest. |
| Risk Element C2: Spread potential | Yes | C | In South Africa, *H. armigera* lays an average of 730 eggs over an oviposition period of 10-23 days; females may produce up to 11 generations per year in tropical climates. Larvae have limited mobility, but adults can fly long distances (CABI, 2012). |
| Risk Element C: Pest introduction is likely to cause unacceptable direct impacts | Yes | N/A | |
| **Conclusion** | | | |
| Is the pest likely to cause unacceptable consequences in the PRA area? | Yes | N/A | |

[a] C=Certain, MC=Moderately Certain, MU=Moderately Uncertain, U=Uncertain

### 3.2.4. *Icerya seychellarum*

We determined the overall likelihood of introduction to be Negligible. We present the results of this assessment in the table below.

**Determination of the portion of the PRA Area endangered by *Icerya seychellarum***

| | |
|---|---|
| Climatic suitability | This pest is distributed throughout much of subtropical and tropical Asia. It also occurs in several African countries, Oceania, and some countries in South America (CABI, 2012). Based on its global distribution, this pest could survive in U.S. Plant Hardiness Zones 9-11. |
| Potential hosts at risk in PRA Area | The pest feeds on a large number of hosts in various families (CABI, 2012) (see below). Many of its hosts are widely distributed and abundant in the continental United States, including plant hardiness zones 9-11. |
| Economically important hosts at risk | Economically important hosts growing in plant hardiness zones 9-11 in the United States include peach, pomegranate, mango, guava, avocado, fig, date, |

| | |
|---|---|
| | paw paw, grape, sweet potato, tomato, lettuce, and beans (CABI, 2012). |
| Pest potential on economically important hosts at risk[a] | *Icerya seychellarum* killed fruit trees in the Pacific Islands (Williams and Watson, 1990) and is a pest of fruit trees in the Seychelles, the Mascarene Islands, and Japan (CABI, 2012). |
| **Defined Endangered Area** | Peach, pomegranate, avocado, grape, sweet potato, tomato, lettuce, and bean crops in plant hardiness zones 9 to 11 in the continental United States are at risk. |

[a] As defined by ISPM No. 11, supplement 2, "economically" important hosts refers to both commercial and non-market (environmental) plants (IPPC, 2011).

**Assessment of the likelihood of introduction of *Icerya seychellarum* into the endangered area via the importation of garden beans from Egypt**

| Risk Element | Risk Rating | Uncertainty Rating[a] | Justification for rating and explanation of uncertainty (and other notes as necessary) |
|---|---|---|---|
| **Likelihood of Entry** | | | |
| Risk Element A1: Pest prevalence on the harvested commodity (= the baseline rating for entry) | Low | MU | We found no information about the prevalence of *I. seychellarum* on beans. In other crops, pest populations seem to be generally low (Newberry and Hill, 1985), perhaps because of natural enemies (Hill, 1983). Therefore, we rated the prevalence of *I. seychellarum* as low. |
| Risk Element A2: Likelihood of surviving post-harvest processing before shipment | Low | U | For this risk assessment, we assume that no post-harvest processing takes place. We also have no evidence that the population could increase during the time between harvest and transport. |
| Risk Element A3: Likelihood of surviving transport and storage conditions of the consignment | Low | U | We found no evidence that the standard shipping and storage conditions would lead to an increase or a decrease of the pest population. |
| Risk Element A: Overall risk rating for likelihood of entry | Low | N/A | |
| **Likelihood of Establishment** | | | |
| Risk Element B1: Likelihood of coming into contact with host material in the endangered area | Negligible | MC | Beans for consumption are usually eaten. Only a tiny fraction will be discarded, and of those, only a tiny fraction will be discarded outdoors. Adult *I. seychellarum* are immobile; only the immature stage (crawler) can move on its own, but only over very short distances (generally less than 1m) (Magsig-Castillo et al., 2010). Crawlers can disperse over long distances by wind, but that requires climbing high enough to encounter suitable air movement, and then being blown onto a |

| Risk Element | Risk Rating | Uncertainty Rating[a] | Justification for rating and explanation of uncertainty (and other notes as necessary) |
|---|---|---|---|
| | | | suitable host plant (CABI, 2012). Additionally, crawler production would have to coincide with when the pod is discarded. Finally, suitability of climate and availability of hosts are limited to parts of the year in most of the endangered area. Overall, because the pest life stage present is highly unlikely to develop into a dispersing life stage, and that life stage is highly unlikely to move on its own from the commodity to a new host, we rated this element Negligible. |
| Risk Element B2: Likelihood of arriving in the endangered area | N/A | N/A | |
| Risk Element B: Combined likelihood of establishment | Negligible | N/A | |
| **Overall Likelihood of Introduction** | | | |
| Combined likelihoods of entry and establishment | **Negligible** | N/A | |

[a] C=Certain, MC=Moderately Certain, MU=Moderately Uncertain, U=Uncertain

3.2.5. *Lampides boeticus*

We determined the overall likelihood of introduction to be Medium. We present the results of this assessment in the table below.

We determined that the establishment of *L. boeticus* in the continental United States is likely to cause unacceptable impacts. We present the results of this assessment in the table below.

**Determination of the portion of the continental United States endangered by *Lampides boeticus***

| | |
|---|---|
| Climatic suitability | This pest is present in southern Europe, Africa, Oceania, the Middle East, and southern Asia (CABI, 2012). Based on this distribution, we estimate it could establish in USDA Plant Hardiness Zones 8-11. |
| Potential hosts at risk in PRA Area | Suitable hosts for *L. boeticus*, including various types of beans and peas (CABI, 2012), are grown in all of these plant hardiness zones. |
| Economically important hosts at risk | Economically important hosts in these plant hardiness zones include soybean, snap bean, lima bean, sweet pea, and Lucerne (NASS, 2009; CABI, 20122). |
| Pest potential on economically important hosts at risk[a] | In Hawaii, *L. boeticus* is a major pest of garden beans (CABI, 2012). In India, damage to pods and locules of peas averaged 8 percent, which was considered significant (CABI, 2012). |
| **Defined Endangered Area** | Soybean, snap bean, lima bean, sweet pea, and lucerne crops in plant hardiness zones 8 to 11 in the continental United States are at risk. |

[a] As defined by ISPM No. 11, supplement 2, "economically" important hosts refers to both commercial and non-market (environmental) plants (IPPC, 2011).

**Assessment of the likelihood of introduction of *Lampides boeticus* into the endangered area via the importation of garden beans from Egypt**

| **Risk Element** | **Risk Rating** | **Uncertainty Rating**[a] | **Justification for rating and explanation of uncertainty (and other notes as necessary)** |
|---|---|---|---|
| **Likelihood of Entry** | | | |
| Risk Element A1: Pest prevalence on the harvested commodity (= the baseline rating for entry) | High | MC | *Lampides boeticus* is common in Egypt, where it was one of the most abundant insects in alfalfa fields (Shebl et al., 2009) and a dominant species in cowpeas (Abdel-Rahman and Amro, 2004). *Phaseolus vulgaris* is among the preferred hosts of this pest. |
| Risk Element A2: Likelihood of surviving post-harvest processing before shipment | High | U | Production, harvesting, and post-harvest procedures in the exporting area are not being considered as part of the assessment. |
| Risk Element A3: Likelihood of surviving transport and storage conditions of the consignment | High | U | We found no evidence that the standard shipping and storage conditions would lead to an increase or a decrease of the pest population. |
| Risk Element A: Overall risk rating for likelihood of entry | High | N/A | |
| **Likelihood of Establishment** | | | |
| Risk Element B1: Likelihood of coming into contact with host material in the endangered area | Low | MC | Beans for consumption are usually eaten. Only a tiny fraction will be discarded, and of those, only a tiny fraction will be discarded outdoors. The life stage entering with green pods would be larvae (CABI, 2012), which have to complete development before they could fly to a host plant. Beans will start decomposing as soon as they are discarded, so larval development would have to be completed in a short time. Then, pupal development needs to successfully occur. After a female emerges, it would have to find an adult male, mate successfully, and then find a host plant. Finally, suitability of climate and availability of hosts would be limited to part of the year in most parts of the endangered area. |
| Risk Element B2: Likelihood of arriving in the endangered area | High | MC | More than 25 percent of the U.S. population lives in the endangered area. |
| Risk Element B: Combined likelihood of establishment | Medium | N/A | |
| **Overall Likelihood of Introduction** | | | |
| Combined likelihoods of entry and establishment | Medium | N/A | |

[a] C=Certain, MC=Moderately Certain, MU=Moderately Uncertain, U=Uncertain

**Assessment of the consequences of introduction of *Lampides boeticus* into the continental United States**

| Criteria | Meets criteria? (Y/N) | Uncertainty Rating[a] | Justification for rating and explanation of uncertainty (and other notes as necessary) |
|---|---|---|---|
| **Direct Impacts** | | | |
| Risk Element C1: Damage potential in the endangered area | Yes | MU | *Lampides boeticus* is a major pest of green beans in Hawaii (CABI, 2012). Green beans are grown throughout all of the endangered area. |
| Risk Element C2: Spread potential | Yes | C | *Lampides boeticus* can fly long distances (CABI, 2012), and routinely migrates from southern to northern Europe, and to Africa. Moreover, the species has established in New Zealand and Hawaii (CABI, 2012). |
| Risk Element C: Pest introduction is likely to cause unacceptable direct impacts | Yes | N/A | |
| **Conclusion** | | | |
| Is the pest likely to cause unacceptable consequences in the PRA area? | Yes | N/A | |

[a] C=Certain, MC=Moderately Certain, MU=Moderately Uncertain, U=Uncertain

### 3.2.6. *Maconellicoccus hirsutus*

We determined the overall likelihood of introduction to be Negligible. We present the results of this assessment in the table below.

**Determination of the portion of the PRA Area endangered by *Maconellicoccus hirsutus***

| | |
|---|---|
| Climatic suitability | *Maconellicoccus hirsutus* is present in many parts of Asia, Africa, Oceania, the Middle East, and the Caribbean and in some parts of the southern and western United States (CABI, 2012). Based on this distribution, we estimate that it may establish in the United States throughout Plant Hardiness Zones 7-11. |
| Potential hosts at risk in PRA Area | The pest feeds on a large number of hosts in various families, including ornamentals and native plants (CABI, 2012). Many of its hosts are widely distributed and abundant in the continental United States. |
| Economically important hosts at risk | Numerous economically important hosts grow in plant hardiness zones 7-11 in the United States, including citrus, avocado, cherry, plum, pepper, grapes, corn, beans and peas, eggplant, potato, cucumber, cabbage, squash, okra, and tomato (CABI, 2012). |
| Pest potential on economically important hosts at risk[a] | In India, *M. hirsutus* has caused economic losses in cotton, grapevine, mulberry, and pigeonpea (CABI, 2012). These hosts occur in the United States in Plant Hardiness Zones 7-11. |

| | |
|---|---|
| **Defined Endangered Area** | The crops mentioned above are at risk in plant hardiness zones 7 to 11 in the continental United States, except for those states where the pest has already established (California, Florida, Texas) (Horton, 2008; National Invasive Species Council, No Date; Stang, 2009). |

[a] As defined by ISPM No. 11, supplement 2, "economically" important hosts refers to both commercial and non-market (environmental) plants (IPPC, 2011).

### Assessment of the likelihood of introduction of *Maconellicoccus hirsutus* into the endangered area via the importation of garden beans from Egypt

| Risk Element | Risk Rating | Uncertainty Rating[a] | Justification for rating and explanation of uncertainty (and other notes as necessary) |
|---|---|---|---|
| **Likelihood of Entry** | | | |
| Risk Element A1: Pest prevalence on the harvested commodity (= the baseline rating for entry) | Low | MC | *Maconellicoccus hirsutus* is likely to be highly visible on green beans because the pest forms colonies that become covered by white, woolly, wax material (CABI, 2012). Routinely harvesting and exporting even moderately infested beans would not be commercially viable and is unlikely to occur. Therefore, pests are only likely to occur on harvested beans at low (less visible) densities. |
| Risk Element A2: Likelihood of surviving post-harvest processing before shipment | Low | U | For this risk assessment, we assume that no post-harvest processing takes place. We also have no evidence that the population could increase during the time between harvest and transport. |
| Risk Element A3: Likelihood of surviving transport and storage conditions of the consignment | Low | U | We found no evidence that the standard shipping and storage conditions would lead to an increase or a decrease of the pest population. |
| Risk Element A: Overall risk rating for likelihood of entry | Low | N/A | |
| **Likelihood of Establishment** | | | |
| Risk Element B1: Likelihood of coming into contact with host material in the endangered area | Negligible | MC | Beans for consumption are usually eaten. Only a tiny fraction will be discarded, and of those, only a tiny fraction will be discarded outdoors. Adult *M. hirsutus* are immobile; only the immature stage (crawler) can disperse, but only over very short distances (Caribbean Pest Information Network, No Date). Crawlers can disperse over long distances by wind, but that requires climbing high enough to encounter suitable air movement, and then being blown onto a suitable host plant (CABI, 2012). Additionally, crawler production would |

| Risk Element | Risk Rating | Uncertainty Rating[a] | Justification for rating and explanation of uncertainty (and other notes as necessary) |
|---|---|---|---|
| | | | have to coincide with when the pod is discarded. Finally, suitability of climate and availability of hosts are limited to parts of the year in most of the endangered area. Overall, because the pest life stage present is highly unlikely to develop into a dispersing life stage, and that life stage is highly unlikely to move on its own from the commodity to a new host, we rated this element Negligible. |
| Risk Element B2: Likelihood of arriving in the endangered area | N/A | N/A | |
| Risk Element B: Combined likelihood of establishment | Negligible | N/A | |
| **Overall Likelihood of Introduction** | | | |
| Combined likelihoods of entry and establishment | **Negligible** | N/A | |

[a] C=Certain, MC=Moderately Certain, MU=Moderately Uncertain, U=Uncertain

3.2.7. *Spodoptera littoralis*

We determined the overall likelihood of introduction to be Medium. We present the results of this assessment in the table below.

We determined that the establishment of *S. littoralis* in the continental United States is likely to cause unacceptable impacts. We present the results of this assessment in the table below.

**Determination of the portion of the continental United States endangered by *Spodoptera littoralis***

| | |
|---|---|
| Climatic suitability | The insect is recorded in Africa, southern Europe, and the Middle East (CABI, 2012). Therefore, we estimate it could establish in USDA Plant Hardiness Zones 8-11. |
| Potential hosts at risk in PRA Area | The host range of *S. littoralis* comprises over 40 families, and suitable hosts are present throughout plant hardiness zone 8-11. |
| Economically important hosts at risk | Economically important hosts in these plant hardiness zones include cotton, tobacco, potato, tomato, onion, citrus, beans, peppers, grapes, alfalfa, and various grasses (CABI, 2012). |
| Pest potential on economically important hosts at risk[a] | EPPO (2006a) states the following:<br>• *Spodoptera littoralis* is one of the most destructive agricultural lepidopterous pests within its subtropical and tropical range.<br>• It is polyphagous and attacks a number of economically important hosts.<br>• On cotton, the pest may cause considerable damage.<br>• Pods and seeds of cowpeas are often badly damaged.<br>• In tomatoes, larvae bore into the fruit, making them unmarketable. |

| | |
|---|---|
| | • In Italy, it is an important pest of protected crops of ornamentals and vegetables. |
| **Defined Endangered Area** | Cotton, tobacco, potato, tomato, onion, citrus, beans, peppers, grapes, alfalfa, and various grass crops in plant hardiness zones 8 to 11 in the continental United States are at risk for *S. littoralis* establishment. |

[a] As defined by ISPM No. 11, supplement 2, "economically" important hosts refers to both commercial and non-market (environmental) plants (IPPC, 2011).

**Assessment of the likelihood of introduction of *Spodoptera littoralis* into the endangered area via the importation of garden beans from Egypt**

| Risk Element | Risk Rating | Uncertainty Rating[a] | Justification for rating and explanation of uncertainty (and other notes as necessary) |
|---|---|---|---|
| **Likelihood of Entry** | | | |
| Risk Element A1: Pest prevalence on the harvested commodity (= the baseline rating for entry) | High | MC | *Spodoptera littoralis* is widespread in Egypt (CABI, 2012). *Phaseolus vulgaris* is among the preferred hosts of this pest. |
| Risk Element A2: Likelihood of surviving post-harvest processing before shipment | High | U | Production, harvesting, and post-harvest procedures in the exporting area are not being considered as part of the assessment. |
| Risk Element A3: Likelihood of surviving transport and storage conditions of the consignment | High | U | We found no evidence that the standard shipping and storage conditions would lead to an increase or a decrease of the pest population. |
| Risk Element A: Overall risk rating for likelihood of entry | High | N/A | |
| **Likelihood of Establishment** | | | |
| Risk Element B1: Likelihood of coming into contact with host material in the endangered area | Low | MC | Beans for consumption are usually eaten. Only a tiny fraction will be discarded, and of those, only a tiny fraction will be discarded outdoors. The life stage entering with green pods would be larvae (CABI, 2012), which have to complete development before they could fly to a host plant. Beans will start decomposing as soon as they are discarded, so larval development would have to be completed in a short time. Then, pupal development needs to successfully occur. After a female emerges, it would have to find an adult male, mate successfully, and then find a host plant. Finally, suitability of climate and availability of hosts would be limited to part of the year in most parts of the endangered area. |
| Risk Element B2: Likelihood of arriving in the endangered area | High | MC | More than 25 percent of the U.S. population lives in the endangered area. |

| Risk Element | Risk Rating | Uncertainty Rating[a] | Justification for rating and explanation of uncertainty (and other notes as necessary) |
|---|---|---|---|
| Risk Element B: Combined likelihood of establishment | Medium | N/A | |
| **Overall Likelihood of Introduction** | | | |
| Combined likelihoods of entry and establishment | Medium | N/A | |

[a] C=Certain, MC=Moderately Certain, MU=Moderately Uncertain, U=Uncertain

**Assessment of the consequences of introduction of *Spodoptera littoralis* into the continental United States**

| Criteria | Meets criteria? (Y/N) | Uncertainty Rating[a] | Justification for rating and explanation of uncertainty (and other notes as necessary) |
|---|---|---|---|
| **Direct Impacts** | | | |
| Risk Element C1: Damage potential in the endangered area | Yes | MC | As discussed above (Endangered Area table), this pest seems likely to cause economic damage in the continental United States if introduced, despite a lack of more specific, quantitative information. |
| Risk Element C2: Spread potential | Yes | C | The flight range of this pest can be up to 1.5 km in four hours (EPPO, 2006a). In optimal climates, the pest can have up to 7 overlapping generations per year, with an average of 20-1000 eggs produced by each female (CABI, 2012). |
| Risk Element C: Pest introduction is likely to cause unacceptable direct impacts | Yes | N/A | |
| **Conclusion** | | | |
| Is the pest likely to cause unacceptable consequences in the PRA area? | Yes | N/A | |

[a] C=Certain, MC=Moderately Certain, MU=Moderately Uncertain, U=Uncertain

## 4. Summary and Conclusions of Risk Assessment

Of the organisms associated with green beans worldwide and reported in Egypt, we identified organisms that are actionable pests for the continental United States and have a reasonable likelihood of being associated with the commodity following harvesting from the field and prior to any post-harvest processing. We evaluated these organisms for their likelihood of introduction (i.e., entry plus establishment) and their potential consequences of introduction. Pests that meet the threshold to likely cause unacceptable consequences of introduction and receive an overall likelihood of introduction risk rating above Negligible are candidates for risk management. The results of this risk assessment represent a baseline estimate of the risks associated with the import commodity pathway as described in section 1.4. (i.e., green beans in pods or shelled with no mandatory production or post-harvest processes).

Of the pests selected for further analysis, we determined that those identified below (Table 4) are *not* candidates for risk management, either because no portion of the continental United States is likely to be endangered by the pest, they do not meet the threshold to likely cause unacceptable consequences of introduction, and/or because they received a Negligible overall risk rating for likelihood of introduction into the endangered area via the import pathway. We summarize the results for each pest below (Table 4).

All the other pests selected for further analysis are candidates for risk management, because they meet the threshold to likely cause unacceptable consequences of introduction, and they received an overall likelihood of introduction risk rating above Negligible. We summarize the results for each pest below (Table 5).

Detailed examination and choice of appropriate phytosanitary measures to mitigate pest risk are part of the pest risk management phase within APHIS and are not addressed in this document.

**Table 4.** Summary for pests selected for further evaluation and determined *not* to be candidates for risk management

| Pest | Endangered area within the PRA area | Meets unacceptable Consequences of Introduction threshold | Likelihood of Introduction overall rating |
|---|---|---|---|
| *Bruchus tristis* | Yes | N/A | Negligible |
| *Icerya seychellarum* | Yes | N/A | Negligible |
| *Maconellicoccus hirsutus* | Yes | N/A | Negligible |

**Table 5.** Summary for pests selected for further evaluation and determined to be candidates for risk management (All meet the threshold for unacceptable consequences of introduction.)

| Pest | Likelihood of Introduction overall rating |
|---|---|
| *Lampides boeticus* | Medium |
| *Chrysodeixis chalcides* | Medium |
| *Helicoverpa armigera* | Medium |
| *Spodoptera littoralis* | Medium |

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# 7. Appendix

**Appendix A.** Pests with non-actionable regulatory status

We found some evidence of the below listed organisms being associated with fresh green beans for consumption, in pods or shelled, and being present in the Egypt; however, because these organisms have non-actionable regulatory status for the continental United States, we did not list them in Table 2 of this risk assessment.

Below we list these organisms along with the references supporting their potential association with fresh green beans (*Phaseolus vulgaris* Linnaeus) for consumption, in pods or shelled, their potential presence in Egypt, their presence in the continental United States (if applicable), and their regulatory status for the continental United States. For organisms *not* present in the continental United States, we also provide justification for their non-actionable status.

| Organism | Evidence and/or other notes |
| --- | --- |
| **ARTHROPODS** | |
| *Acanthoscelides obtectus* (Say) | PestID, 2012; CABI, 2012 |
| *Acyrthosiphon pisum* (Harris)<br>(= *Macrosiphum pisum* (Harris)) | PestID, 2012; El Kifl et al., 1974; CABI, 2012 |
| *Agrotis ipsilon* (Hufnagel) | El Kifl et al., 1974; PestID, 2012 |
| *Aphis craccivora* Koch<br>(= *A. laburni* Kaltenbach) | CABI, 2012; El Kifl et al., 1974; Favret, 2012; PestID, 2012 |
| *Aphis fabae* Scopoli<br>(= *A. compositae* Theobald) | PestID, 2012; CABI, 2012 |
| *Aphis gossypii* Glover | CABI, 2012; PestID, 2012; CABI, 2012 |
| *Aphis nerii* Boyer de Fonscolombe | CABI, 2012; Raupach et al., 2002; CABI, 2012 |
| *Bemisia afer* (Priesner & Hosny) | Abd-Rabou and Ahmed, 2008; PestID, 2012; Thindwa and Khonje, 2005 |
| *Bemisia tabaci* (Gennadius) | CABI, 2012; PestID, 2012; CABI, 2012 |
| *Bemisia tabaci* (Gennadius) (B biotype)<br>(= *B. argentifolii* Bellows, Perring, Gill and Hendrick) (CABI, 2012) | Abd-Rabou, 2006; CABI, 2012; PestID, 2012; Rodríguez et al., No Date; CABI, 2012 |
| *Bemisia tabaci* (Gennadius) (Q biotype) | Brown, 2007; Iida et al., 2009; Mckenzie, 2011; PestID, 2012 |
| *Brevipalpus californicus* (Banks) | CABI, 2012; PestID, 2012; CABI, 2012 |
| *Brevipalpus obovatus* Donnadieu | CABI, 2012; PestID, 2012; CABI, 2012 |
| *Brevipalpus phoenicis* (Geijskes) | CABI, 2012; Childers et al., 2003; PestID, 2012; CABI, 2012 |
| *Callosobruchus chinensis* (Linnaeus) | CABI, 2012; PestID, 2012; CABI, 2012 |
| *Callosobruchus maculatus* (Fabricius) | Gentry, 1965; PestID, 2012; CABI, 2012 |
| *Bruchus rufimanus* Boheman | Gentry, 1965; PestID, 2012; CABI, 2012 |
| *Carpophilus hemipterus* (Linnaeus) | CABI, 2012; PestID, 2012; CABI, 2012 |
| *Delia platura* (Meigen) | CABI, 2012 |
| *Etiella zinckenella* (Treitschke) | PestID, 2012; CABI, 2012 |

| Organism | Evidence and/or other notes |
|---|---|
| *Frankliniella schulzei* (Trybom) | CABI, 2012; PestID, 2012; Seif et al., 2001; CABI, 2012 |
| *Gryllotalpa gryllotalpa* (Linnaeus) | CABI, 2012; El Kifl et al., 1974; PestID, 2012; CABI, 2012 |
| *Hypera postica* (Gyllenhal) | PestID, 2012; CABI, 2012 |
| *Lampides boeticus* Linnaeus | PestID, 2012; CABI, 2012 |
| *Liriomyza trifolii* Burgess | PestID, 2012; CABI, 2012 |
| *Macrosiphum euphorbiae* Thomas | PestID, 2012; CABI, 2012 |
| *Myzus persicae* Sulzer | El-Lakwa et al., 1999; PestID, 2012 |
| *Nezara viridula* (Linnaeus) | Khalafallah et al., 2005; PestID, 2012 |
| *Ostrinia nubilalis* (Hübner) | CABI, 2012; PestID, 2012; CABI, 2012 |
| *Pieris rapae* Linnaeus | El Kifl et al., 1974; PestID, 2012 |
| *Pinnaspis buxi* (Bouché) | Ben-Dov et al., 2012; PestID, 2012 |
| *Pinnaspis strachani* (Cooley) | Ben-Dov et al., 2012; PestID, 2012 |
| *Planococcus citri* (Risso) | Ben-Dov et al., 2012; PestID, 2012 |
| *Pseudaulacaspis pentagona* (Targoni-tozzetti) | Ben-Dov et al., 2012; PestID, 2012 |
| *Rhopalosiphum rufiabdominale* (Sasaki) | PestID, 2012; CABI, 2012 |
| *Sitona lineatus* Linnaeus | PestID, 2012; CABI, 2012 |
| *Sitophilus zeamais* Motschulsky | PestID, 2012; CABI, 2012 |
| *Smynthurodes betae* Westwood | Gentry, 1965; PestID, 2012 |
| *Spodoptera exigua* (Hübner) | PestID, 2012; CABI, 2012 |
| *Tetranychus cinnabarinus* (Boisduval) (= *T. cucurbitacearum* (Sayed), *T. telarius*) | PestID, 2012; CABI, 2012 |
| *Tetranychus urticae* Koch (= *T. arabicus* Attiah) | PestID, 2012; Zaher et al., 1979; CABI, 2012 |
| *Tetranychus atlanticus* Mcgregor | Canerday and Arant, 1964; Gentry, 1965; PestID, 2012 |
| *Thrips tabaci* Lindeman | CABI, 2012; PestID, 2012; CABI, 2012 |
| *Tribolium castaneum* Herbst | PestID, 2012; CABI, 2012 |
| *Trichoplusia ni* (Hübner) (= *Plusia ni* (Hübner) | PestID, 2012; El Kifl et al., 1974; CABI, 2012 |
| *Vanessa cardui* (Linnaeus) | Gentry, 1965; PestID, 2012 |
| **PATHOGENS** | |
| **Bacteria** | |
| *Burkholderia cepacia* (Burkholder) Palleroni & Homes; (= *Pseudomonas cepacia; Pseudomonas cepacia*) | EG, US: CABI, 2012; Bradbury, 1986 |
| *Pectobacterium carotovorum* subsp. *carotovorum* (Jones) Hauben et al., comb. nov.; (= *Erwinia carotovora subsp. atroseptica* (Jones) Bergey et al.) | EG: CABI, 2012; US: Bradbury, 1986 |
| *Pseudomonas marginalis* pv. *marginalis* (Brown) Stevens | EG: CABI, 2012; US: Bradbury, 1986, |

| **Organism** | **Evidence and/or other notes** |
|---|---|
| *Pseudomonas savastanoi* pv. *phaseolicola* (Burkholder) Gardan et al. (= *P. syringae* pv. *phaseolicola* (Burkholder) Young et al.) | EG: CABI, 2012; US: Bradbury, 1986 |
| *Pseudomonas syringae* pv. *pisi* (Sackett) Young et al. | EG: US: CABI, 2012; US:Bradbury, 1986 |
| *Pseudomonas syringae* pv. *syringae* van Hall | EG: CABI, 2012; US: Bradbury, 1986 |
| *Pseudomonas viridiflava* (Burkholder) Dowson | EG: CABI, 2012; US: Bradbury, 1986 |
| *Rhizobium radiobacter* (Beijerinck and van Delden) Young et al. | EG: CABI, 2012; US: Bradbury, 1986 |
| *Xanthomonas axonopodis pv. alfalfae* (Riker et al.) Vauterin et al. | EG, US: CABI, 2012 |
| *Xanthomonas axonopodis* pv. *phaseoli* (Smith) Vauterin et al. (= *X. campestris* pv. *phaseoli* (Smith) Dye) | EG: CABI, 2012; US: Bradbury, 1986 |
| **Fungi** | |
| *Alternaria alternata* (Fr.) Keissl. (= *A. tenuis* Nees) | EG: Farr et al., 2007; Ministry of Agriculture and Land Reclamation, 2006 |
| *Alternaria brassicicola* (Schwein.) Wiltshire | EG, US: CABI, 2012; Farr et al., 2007 |
| *Aspergillus flavus* Link | EG, US: CABI, 2012; Farr et al., 2007 |
| *Aspergillus niger* Tiegh. | EG: CABI, 2012; US: Farr et al., 2007 |
| *Athelia rolfsii* (Curzi) Tu and Kimbr. (= *Corticium rolfsii* Curzi) | EG, US: CABI, 2012; Farr et al., 2007 |
| *Botryotinia fuckeliana* (de Bary) Whetzel (= *Botrytis cinerea* Pers) | EG, US: Farr et al., 2007; CABI, 2012 |
| *Botryosphaeria rhodina* (Berk. & M.A. Curtis) Arx (= *Lasiodiplodia theobromae* (Pat.) Griffon & Maubl.) | EG: Ministry of Agriculture and Land Reclamation, 2006; US: Farr et al., 2007 |
| *Botrytis fabae* Sardiña | EG: Ministry of Agriculture and Land Reclamation, 2006; US: Farr et al., 2012; Koike, 1998; Zitter, 2005 |
| *Choanephora cucurbitarum* (Berk. & Ravenel) Thaxt. | EG, US: CABI, 2012 |
| *Cochliobolus lunatus* R.R. Nelson & Haasis | EG, US: CABI, 2012 |
| *Cochliobolus sativus* (S. Ito & Kurib.) Drechsler ex Dastur (= *Helminthosporium sativum* Pammel, C.M. King and Bakke) | EG: CABI, 2012; US: Farr et al., 2007 |
| *Colletotrichum truncatum* (Schwein.) Andrus & W.D. Moore | EG, US: CABI, 2012; US: Farr et al., 2007 |
| *Corticium rolfsii* Curzi (= *Sclerotium rolfsii*) | EG, US: CABI, 2012 |
| *Diaporthe phaseolorum* (Lehman) Wehm. | EG: CABI, 2012; US: Farr et al., 2007 |
| *Erysiphe betae* (Vaňha) Weltzien (= *E. polygoni* DC.) | EG, US: CABI, 2012 |

| **Organism** | **Evidence and/or other notes** |
|---|---|
| *Fusarium phaseoli* (Burkh.) T. Aoki & O'Donnell | EG, US: CABI, 2012 |
| *Fusarium oxysporum* Schltdl. | EG: CABI, 2012; Ministry of Agriculture and Land Reclamation, 2006; US: Farr et al., 2007 |
| *Glomerella cingulate* (Stoneman) Spauld. & H. Schrenk (= *Colletotrichum gloesporioides* (Penz.) Penz. and Sacc.; *Gibberella avenacea* R.J. Cook; *Fusarium avenaceum* (Fr.: Fr.) Sacc.) | EG, US: Farr et al., 2007 |
| *Gibberella zeae* (Schwein.) Petch | EG: CABI, 2012; US: Farr et al., 2007 |
| *Leveillula taurica* (Lév.) G. Arnaud | EG: CABI, 2012; US: Farr et al., 2007 |
| *Mycosphaerella cruenta* Latham | EG: CABI, 2012; US: Farr et al., 2007 |
| *Penicillium italicum* Wehmer | EG, US: CABI, 2012 |
| *Phoma pinodella* (Jones) Morgan-Jones & Burch (= *Sphaerotheca fuliginea* (Schltdl.) Pollacci) | EG: CABI, 2012; US: Farr et al., 2007 |
| *Phytophthora cryptogea* Pethybr. & Laff. | EG, US: CABI, 2012 |
| *Podosphaera xanthii* (Castagne) U. Braun & Shishkoff (= *Sphaerotheca fuliginea* (schltdl.) Pollacci) | EG: CABI, 2012; US: Farr et al., 2007 |
| *Pythium aphanidermatum* (Edson) Fitzp. | EG: Ministry of Agriculture and Land Reclamation, 2006; US: Farr et al., 2007 |
| *Pythium debaryanum* Hesse | EG, US: Farr et al., 2007 |
| *Pythium irregulare* Buisman | EG: EMoALR, 2006; US: Farr et al., 2007 |
| *Pythium myriotylum* Drechsler | EG: CABI, 2012; US: Farr et al., 2007 |
| *Pythium ultimum* Trow | EG, US: Farr et al., 2007 |
| *Rosellinia necatrix* Berl. Ex | EG, US: Farr et al., 2007 |
| *Sclerotinia sclerotiorum* (Lib.) de Bary | EG: Ministry of Agriculture and Land Reclamation, 2006; US: Farr et al., 2007 |
| *Thanatephorus cucumeris* (A.B. Frank) Donk (= *Rhizoctonia solani* J.G. Kühn) | EG: Ministry of Agriculture and Land Reclamation, 2006; US: Farr et al., 2007; CABI, 2012 |
| *Thielaviopsis basicola* (Berk. & Broome) Ferraris (= *Chalara elegans* Nag Raj & W.B. Kendr.) | EG: CABI, 2012; US: Farr et al., 2007 |
| *Uromyces appendiculatus* F. Strauss (= *U. phaseoli* G. Winter) | EG: Ministry of Agriculture and Land Reclamation, 2006; US: Farr et al., 2007 |
| *Uromyces viciae-fabae* (Pers.) J. Schröt. | EG:Ministry of Agriculture and Land Reclamation, 2006; US: Farr et al., 2007 |
| *Verticillium dahliae* Kleb. | EG: CABI, 2012; US: Farr et al., 2007 |
| **Nematodes** | |
| *Ditylenchus dipsaci* Kühn | EG: CABI, 2012, Hanounik and Bisri, 1991; US: US: Ferris, 2012 |
| *Helicotylenchus dihystera* (Cobb) Sher | EG, US: CABI, 2012 |
| *Helicotylenchus multicinctus* (Cobb) Golden | EG, US: CABI, 2012; |

| Organism | Evidence and/or other notes |
|---|---|
| *Helicotylenchus pseudorobustus* (Steiner) Golden | EG, US: CABI, 2012 |
| *Heterodera glycines* Ichinohe | EG, US: CABI, 2012 |
| *Heterodera schachtii* A. Schdmit | EG, US: CABI, 2012; Ferris, 2012 |
| *Meloidogyne arenaria* Neal Chitwood | EG: Abdel-Dali, 2007; Ibrahim et al., 2000; US: CABI, 2012 |
| *Meloidogyne hapla* Chitwood | EG, US: CABI, 2012 |
| *Meloidogyne incognita* (Kofoid and White) Chitwood | EG, US: CABI, 2012 |
| *Pratylenchus brachyurus* (Godfrey) Filipjev and Schuurmans Stekhoven | EG, US: CABI, 2012 |
| *Pratylenchus penetrans* (Cobb) Chitwood and Oteifa | EG, US: CABI, 2012 |
| *Pratylenchus thornei* Sher and Allen | EG, US: CABI, 2012 |
| *Pratylenchus vulnus* Allen& Jensen | EG: CABI, 2012; US: Koenning et al., 1999 |
| **Viruses** | |
| *Alfalfa mosaic alfamovirus* | EG: CABI, 2012; Makkouk et al., 1994; US: CABI, 2012; , Brunt et al., 1996 |
| *Bean common mosaic necrosis potyvirus* (BCMNV) (= *Bean common mosaic potyvirus* (BCMV)) | EG: Makkouk et al., 1994; Makkouk et al., 1990; US: Brunt et al., 1996 |
| *Bean leafroll luteovirus* | EG: Makkouk et al., 1994; US: CABI, 2012 |
| *Bean yellow mosaic potyvirus* (BYMV) | EG: Makkouk et al., 1994; US: CABI, 2012 |
| *Beet curly top curtovirus* (BCTV) (Geminiviridae) | EG: CABI, 2012; US: Creamer et al., 1996 |
| *Broad bean wilt comovirus* (BBWV) (Fabaviridae) | EG, US: Brunt et al., 1996 |
| *Chickpea chlorotic stunt virus* | EG: Najar et al., 2011 (listed in Tunisia but compared with EG isolates); US: Brunt et al., 1996 |
| *Cucumber mosaic cucumovirus* (CMV) | EG: Makkouk et al., 1994; US: Brunt et al., 1996 |
| *Peanut mottle potyvirus* (PeMoV) | EG: Brunt et al., 1996; US: Brunt et al., 1996 |
| *Soybean dwarf luteovirus* (SbDV) | EG: Makkouk et al., 1994 ; US: (CA) Brunt et al., 1996 |
| *Squash leaf curl virus begomovirus* (SCLCV) (= *Bean Calico Mosaic Virus*) | EG: CABI, 2012; US: Brunt et al., 1996 |
| *Tobacco mosaic Virus tobamovirus* (TMV) | EG: Makkouk et al., 1994; US: Brunt et al., 1996 |
| *Tobacco rattle tobravirus* (TRV) | EG: CABI, 2012; US: Brunt et al., 1996 |
| *Tobacco streak ilarvirus* | EG CABI, 2012; US: Brunt et al., 1996 |
| *Tomato ringspot nepovirus* | EG: CABI, 2012; US: Brunt et al., 1996, |
| *Tomato spotted wilt tospovirus* (TSWV) | EG: Brunt et al., 1996; US: Brunt et al., 1996 |
| *Tomato yellow leaf curl begomovirus* (TYLCV) | EG: Duffy and Holmes, 2007; EPPO, 2005; EPPO, 2012b |
| *Watermelon mosaic potyvirus* (WMV) | EG: CABI, 2012; US: Brunt et al., 1996 |